COMBINED INSENSITIVE MUNITIONS/ FINAL HAZARD CLASSIFICATION TEST PLAN

by

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Abstract

This technical report is based on the development of a generic combined Insensitive Munitions (IM) and Final Hazard Classification (FHC) test plan for Theater Missile Defense, Hit-To-Kill weapons. These weapons use Kinetic Energy (KE) instead of explosive warhead technology to negate threats. The purpose of the combined IM/FHC test plan is to provide a lower cost alternative to the full test protocol for IM and FHC as required by MIL-STD-2I05 and TB 700-2. Implementation of this test plan will provide adequate, thorough test data for both IM and FHC board evaluation at a substantially reduced cost. This test plan includes rationale, analysis and methodology for reducing test assets. The test plan will achieve major cost savings through the elimination of redundant tests, the incorporation of material characterization tests, and the combination of certain similar tests. Expensive tests and assets are reduced to a minimum, yet the integrity and purpose of a full-up test program are maintained.

Background

There are three very important concerns that should be addressed before a project commits resources and assets for an IM/FHC test program. These concerns include the following: (I) the reason the project must test, (2) the benefits of the test program, and (3) the cost (the number of test assets, the time, and the test hardware required) of the complete test program. These questions have been asked by several Program Executive Office for Missile Defense project managers regarding missile systems which rely on pinpoint accuracy to accomplish KE kills. Since these precision interceptor systems are very expensive ($IM+ per asset), any test requirements that have not been anticipated are carefully scrutinized by the project manager. This generic plan was developed to reduce the number of test assets as well as the approval time required for the individual projects tailored test plan. Approval has been secured for the approach outlined in this generic IM/FHC test plan from the Army IM Board (the Munitions Vulnerability Assessment Panel (MVAP)) and the Department of Defense Hazard Classifiers (Department of Defense Explosive Safety Board (DDESB)). This plan will serve as an approved framework for the projects to use in the development of their tailored test plan. The necessary approvals for each project's tailored test plan will therefore be

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accomplished on a revision of an approved document rather than an entirely new test plan. Letters of approval for this plan have been received from the MVAP and the DDESB.

Introduction and Test Objectives

The reactive nature of munitions makes them susceptible to violent, sometimes explosive reactions when subjected to unplanned stimuli (heat, shock, impact) or to planned threats by an opposing force. An Insensitive Munition (IM) is defined as a munition that will reliably fulfill performance, readiness and operational requirements on demand, but will minimize the violence of a reaction and subsequent collateral damage when subjected to unplanned stimuli or threat attacks. The IM test series (as described in MIL-STD-2105B) currently consists of seven types of IM specific tests plus four additional basic safety tests.

The current IM and Final Hazard Classification (FHC) tests are usually performed independently of each other, though many similarities exist between them. Early in this study, some possible avenues for the reduction of test costs with no degradation of test data, became apparent. With some modifications to the IM and FHC test procedures, and the interchange of the test data between the IM and FHC testing agencies, reduction of the number of assets and the number of tests required to accomplish respective test requirements is a real possibility.

Insensitive Munitions

The IM test series currently consists of seven tests: Bullet Impact (BI), Fragment Impact (Fl), Sympathetic Detonation (SD), Fast Cook-Off (FCO), Shaped Charge Jet Impact (SCJ), Spall Impact (51), and Slow Cook-Off (SCO). According to MIL-STD-2105B, these tests are mandatory unless the Threat Hazard Assessment (THA) conducted by the munition project office provides acceptable justification for omission of a particular test. Four basic safety tests are also included in the MIL-STD-2105B: a 28 day temperature and humidity cycling test, a vibration test, a 4 day temperature and humidity cycling test, and a 12 meter drop test. These four tests are part of the basic safety evaluations usually accomplished by the manufacturer or integrator of the munition, and therefore will not be addressed by this study.

The purpose of the seven IM tests is to classify the munition in question in terms of its sensitivity to external stimuli. A determination as to whether or not the munition will be classified as an IM article is made by the MVAP based on the results of the test series.

The IM test series currently requires several repetitions of individual tests on numerous All Up Rounds (AURs). This is an extremely expensive process for expensive, complex munitions. It is also important to note that a test series such as IM (requiring almost forty AURs) can be an impossible burden on limited production munition systems.

Final Hazard Classification

FHC is the process by which specific initiating influences are applied to munitions to determine the reactions of the munitions. The hazard classification test series (as described in

TB 700-2) currently consists of three types of tests. These reactions are used to classify hazardous materials into the appropriate DOD Hazard Class/Division (HC/Div) as well as to determine storage compatibility for the munitions.

The FHC test series is currently comprised of three test procedures performed on AURs; the Single Package test (SP), the Confined Stack test (CS), and the External Fire Stack (EFS) (Bonfire) test. These are mandatory tests as specified by TB 700-2. Only with an approved test plan may any of the hazard classification tests be eliminated. This test series is also extremely costly for expensive, complex munition systems in that it currently requires the use of multiple AURs and multiple test repetitions for each test procedure.

There are also five additional FHC tests specified in TB 700-2 that are performed on small scale laboratory samples. These tests are the thermal stability test, the card gap test, 3 ignition and unconfined burning test, the detonation test, and the impact sensitivity test. These FHC material tests are generally conducted by the munitions manufacturer and are of relatively small cost and therefore will not be addressed by this study.

The purpose of these FHC tests is to classify the test article as per DoD Hazard Classification Guidelines for storage and transportation considerations (see TB 700-2, Chapter Four - Explosives Hazard Classification for more detail). The FHC tests must be complete and approved before material release of the munition can be accomplished.

Assumptions.

This generic Combined IM/FHC Test Plan was developed for Theater Missile Defense(TMD), Hit-To-Kill type missiles using Kinetic Energy (KE) for kill instead of explosive warhead technology. Several assumptions were made in the development of this test plan:

l.) HC/Div 1.3 propellant in rocket motor, i.e., no HC/Div 1.1~propellant.
2.) No appreciable amount of HC/Div 1.1 explosive material, i.e., no warhead. 3.) Tactical and storage configurations are the same, i.e. missile tested in the canister.

This generic Combined IM/FHC test series is easily adaptable for HC/Div 1.1 type systems, i.e., detonable warhead and/or propellant.

Required Assets.

The full IM and FHC test series currently consists of a total of 10 different tests, some of which require multiple repetitions, for a total of 20 tests. In order to perform these tests, 37 assets are required. This total includes 13 tests on 14 AURs as specified in MIL-STD 2105B, and 7 tests on 23 AURs as specified in TB 700-2.

The Combined IM/FHC test plan, through the analysis accomplished in this study, reduces the total number of IM and FHC tests to a maximum of 8, performed on 9 AURs. The tests and assets required

for the Combined IM/FHC test plan are provided in Table 1. However, the total number of AURs and tests may be decreased further depending on the results of the THA (for IM) or if suitable analogous tested items exist for FHC (as allowed by TB 700-2).

TABLE 1.

Test Activity	# Assets Required	# Tests Required
Bullet Impact Test	1 ACM/DACS 1 rocket motor	2
Fragment Impact Test	1 ACM/DACS 1 rocket motor	2
Confined Stack Test	2 AURs	1
Sympathetic Detonation Test	2 AURs	1
Shaped Charged Jet Test	1 rocket motor	1
Fast Cook-Off/External Fire Stack Test	2 AURs	1
Total AURs	9	
Spare AURs	1	
Total AURs and Tests Required	**10**	**8**

Table 1. Combined IM/FHC Test and Asset Requirements

Recommended Subscale Tests

The Combined IM/FHC Test Plan is based on the usage of certain low cost subscale tests, the deletion of certain non-applicable tests, and the reduction of test repetitions. Several low cost subscale material characterization tests currently in use throughout the energetic material industry were evaluated for inclusion in this test plan. Subscale tests were chosen for their similarities to IM and FHC tests. The subscale tests chosen for inclusion in the Combined IM/FHC Test Plan are the super card gap test, the critical diameter test, the wedge test, the shotgun test, and the closed bomb burn rate test. These tests are addressed in the following sections. Table 2 indicates each subscale test which when performed, will have a bearing on the corresponding full scale tests. These subscale tests are not recommended as replacements for full scale tests but are implemented to reduce the need for repetitious testing (as used by current test methodology).

TABLE 2.

Subscale Test	Full scale Test
Super Card Gap Test	IM Bullet Impact Test IM Fragment Impact Test IM Sympathetic Detonation Test
Critical Diameter Test	IM Bullet Impact Test IM Fragment Impact Test IM Shaped Charge Jet Test IM Sympathetic Detonation Test
Wedge Test	IM Bullet Impact Test IM Fragment Impact Test IM Sympathetic Detonation Test
Closed Bomb Burn Rate Test	IM Fast Cook-Off Test FHC External Fire Stack Test
Shotgun Test	IM Fast Cook-Off Test IM Bullet Impact Test IM Fragment Impact Test

Table 2. Full Scale/Subscale Test Relationships.

Certain IM and FHC tests were omitted from this test plan as a means of reducing test costs. Regarding IM tests, the spall impact test was omitted due to its low probability of occurrence with the type of munitions and deployment strategy for which this test plan was developed.

The current designs of the large scale missiles for which this plan was developed is such that it is not likely they would pass the SCO as prescribed in MIL-STD-2l05B. Currently, there is no requirement for these systems to be used/transported within the Navy (where SCO type threats are most likely). However; this may change and if so must be addressed in the individual weapon system's THA. In keeping with the Army Supplement to MIL-STD-2l05, the SCO will not be performed unless the THA indicates such a threat is credible, and therefore was omitted from this test plan..

The FHC SP test was omitted from this test plan due to the fact that according to TB 700-2, the SP test is to be used only if severe test results are not expected in this configuration. TB 700-2 specifies that if severe results are expected the SP test shall be skipped and the CS test performed. Benign results are not expected with test articles of this type under CS conditions and therefore this test was eliminated.

The subscale test data should be fully documented with commonly accepted instrumentation. A typical scientific test report should be generated.

Super Card gap Test

The super card gap test consists of the detonation of a booster material above a compressed sample of the test energetic material. The booster and sample are stacked in a steel acceptor canister and are

separated by a shock attenuating material. The gap thickness will be varied to determine the critical thickness. The test is repeated approximately eight times at a total test cost of approximately $26,000. The super card gap test is typically performed on materials with a large failure diameter (i.e.,> 25 mm). Implementation of the super card gap test prior to full scale tests will reveal the munitions general sensitivity to shock.

Critical Diameter Test

The critical diameter of a material is the minimum material diameter at which a detonation can be sustained. The critical diameter of a material may be measured by the initiation of various diameter cylinders of the energetic material, initiation of a conical sample of the energetic material, or initiation of a stepped cylindrical sample of the material. This test series should cost approximately $25,000. The critical diameter test provides a means of predicting the detonation characteristics of a particular munition based on the munition diameter.

Wedge Test

The wedge test is used to determine the initiating pressure of a material as well as run length and delay time for the material. The wedge test is accomplished by mounting a wedge shaped sample of the energetic material on an aluminized mylar sheet which is attached to a shock attenuator and a plane wave booster. Shock waves of increasing intensity are then transversed through the sample until the initiating pressure is attained. The cost of this test is about $30,000. This test is performed only on materials that have a small failure diameter (i.e., <25 mm). When the wedge test is performed prior to the BI and Fl tests, a decision may be made to test only the rocket motor or only the Attitude Control Motor/Divert Attitude Control System (ACM/DACS) (if applicable) in these tests. This would be possible if the detonation velocities of one of the energetic materials is low enough to preclude testing of that particular component.

Shotgun Test

The shotgun test is a measure of the toughness of a propellant. This test is used to determine the degree of damage to propellants when exposed to high strain rate deformation as a result of sample impact at various velocities. The amount of damage to the impacted propellant can be correlated to its resistance by measuring the velocity at which the propellant samples break apart after being fired from a 12 gauge shotgun into a catch box , and then collecting, weighing and burning the fragments. The results of successful firings at 12 - 15 velocities are plotted (pressure rise rate vs. velocity) and a linear regression analysis is used to locate the intersection of the plotted line with a pressure rise rate 2.5 x 106 psi/second. The velocity thus indicated is termed the Critical Impact Velocity (CIV) and is reported as a figure of merit for propellant toughness. The cost of this test is approximately $15,000 for evaluation of one propellant.

Closed Bomb Burn Rate Test

The closed bomb burn rate test is used to determine the temperature and pressure characteristics of a material. The material samples are placed in a closed combustion bomb (similar to a bomb calorimeter,

only larger) and ignited. A reasonable approximate cost would be in the range of $10,000-20,000. The closed bomb burn rate test when performed before the initiation of the FCO and EFS tests, can be used to assist in predicting the outcome of the FCO and EFS tests.

Recommended Full Scale Tests

The following full scale tests are based on the primary tests required for IM and FHC testing as outlined in MIL-STD-2105B and TB 700-2 as well as the rationale provided in this test plan. Used in conjunction with the recommended subscale tests delineated in this test plan, these full scale tests will satisfy the test requirements for Combined IM/FHC testing. Figure l indicates the recommended full scale tests and the order in which they are to be performed. Due to similar phenomenology and test data requirements, the IM Fast Cook Off test and the FHC External Fire Stack test have been combined.

The order in which the tests are to be accomplished is extremely critical to the success of this test plan approach. As discussed earlier; the data collected during the subscale tests will be used to predict the outcome of certain full scale tests, thereby reducing the need for multiple full scale test repetitions. The test order is structured such that each full scale test provides data that will establish logical sensitivity trends and patterns that should be evident in the following test in the sequence. The sequence therefore allows each test to build on the data from the preceding test reinforcing the validity of the test series results.

The complete test plan, dated 7 June 1994 and titled: Combined Insensitive Munitions 'Final Hazard Classification Test Plan, contains a large volume of information with a complete set of test information (test description, assets required, test configuration, test instrumentation, test procedures, passing criteria (for IM), and test flowchart) and cannot be presented in its entirety in this paper. (If a copy of the entire test plan is desired, a written request should be provided to the Deputy Commander, U.S. Army Space and Strategic Defense Command, ATTN: CSSD-ES, P.O. Box 1500, Huntsville, Alabama 35807-3801). A complete set of the test information is however provided for the Fast Cook-Off/External Fire Stack test, as an example of the data available in the plan. The other tests in the IM/FHC series will be represented herein by their flowcharts only. The blast gage location, amount, and types are provided for the Fast Cook-Off/External Fire Stack test, however; the actual number, locations, and types of blast gages are dependent on the size and type of munition being tested.

Figure I. Combined IM/FHC Test Flowchart

Test Activity	# Assets Required	# Tests Required
Bullet Impact Test	1 ACM/DACS 1 rocket motor	2
Fragment Impact Test	1 ACM/DACS 1 rocket motor	2
Confined Stack Test	2 AURs	1
Sympathetic Detonation Test	2 AURs	1
Shaped Charged Jet Test	1 rocket motor	1
Fast Cook-Off/External Fire Stack Test	2 AURs	1
Total AURs	9	
Spare AURs	1	
Total AURs and Tests Required	**10**	**8**

Table 1. Combined IM/FHC Test and Asset Requirements

Fast Cook-Off/External Fire Stack Test

Test Description.

The Fast Cook-Off/External Fire Stack (FCO/EFS) test combines the requirements of the Fast Cook-Off test (IM test) and the External Fire Stack Test (FHC test) into a single test while preserving each test's fundamental objectives. The goal is to reduce the costs and number of assets required to perform these tests.

The test consists of engulfing the test article for at least thirty minutes in the flame envelope of a fuel fire and recording its reaction as a function of time. The test articles shall be stacked in their storage configuration with all energetic components and materials present. The test is terminated upon completion of the reaction(s) of the test article(s). If the CS test, the SD test, or the SCJ test indicates a propensity to detonate, as a precaution for adequate data collection, fragment collection packs similar to those in TB 700-2 for method 1 should be added.

Assets Required.

Two AURs.

Test Configuration

The recommended test setup for the FCO/EFS test is shown in Figure 2. Test facility construction shall be designed to provide a heat source which completely engulfs the test item at the specified flame temperature for the duration of the test. Test articles shall be stacked in its storage configuration on a

platform approximately 1 meter above the ground.

Fuel

Sufficient hydrocarbon fuel, e.g. JP-4, JP-5, JP-8, JET A-I, or wood, shall be used to insure that the test article reaches the temperatures stated in the following paragraphs and that a reaction occurs while engulfed in the fire. The amount of fuel required is a function of the size of the test site and the characteristics of the test article.

Flame Temperature Rise Rate

The flame temperature shall reach 540^0C (1000^0F) within 30 seconds after ignition as measured by any two thermocouples defined in the following paragraphs. The time over 30 seconds until flame temperature, as measured by the two thermocouples, reaches 540^0C (1000^0F) shall be subtracted from the time of reaction.

Average Flame Temperature

A test with an average flame temperature of at least 870^0C (1600^0F) as measured by all valid thermocouples at the test item without contribution of the burning ordnance will be considered valid. This temperature is to be determined by averaging the temperature from the time the flame reaches 540^0C (10000 F) until all ordnance reactions are completed.

Instrumentation

Airblast overpressure

Measurement of the airblast overpressure produced by the test item shall be used to provide evidence of the test item reaction. The gages shall be capable of recording the pressure as a function of time and have sufficient frequency response to adequately follow the pressure history if the energetic material detonates. The gages shall be calibrated to record the peak pressure expected from the detonation of the test item energetic material. Recommended blast gage types and vendors are shown in Table 3.

Thermocouples

Four thermocouples shall be located outside the test article skin for each item tested. The thermocouples shall be positioned on each end and side of the test article skin in a horizontal plane through the test article center line. Thermocouple readings shall be made and recorded at least once every second throughout the duration of the test (see Table 3).

Photography

High-speed motion picture photography, motion picture sound photography or video shall be used to record the test item reaction. The type of film used, exposure, and frame rates shall be selected by the test activity to provide the resolution necessary to obtain the required data. Still photographs of the test

item and test setup shall be taken before and after the test. At least three motion picture cameras at different angles shall be used to record the test reaction. Photographic data requirements shall comply with DID DI-SAFT-81126. Recommended photographic equipment types are shown in Table 3.

Figure 2. Fast Cook-Off/External Fire Stack Test Schematic.

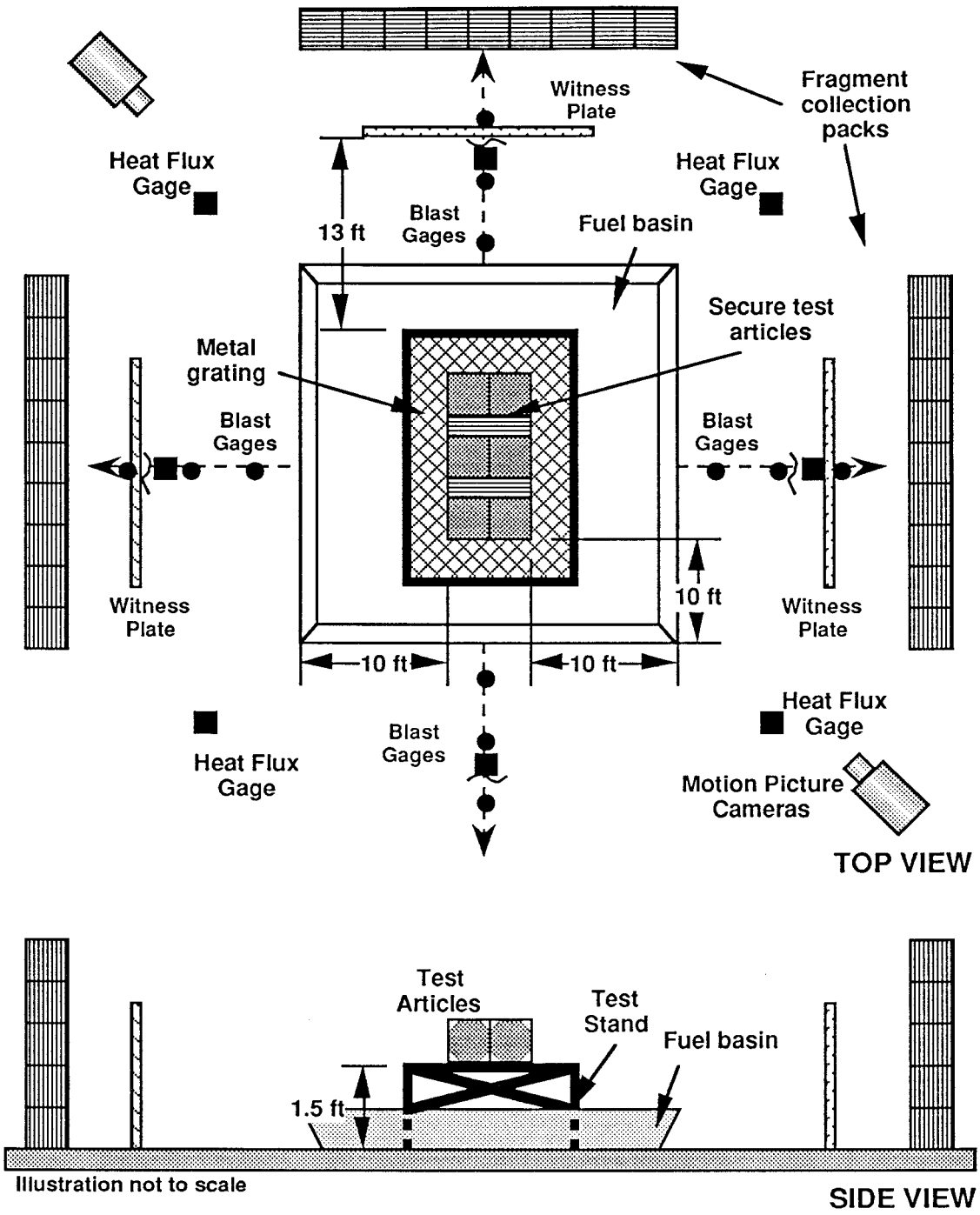


Figure 2. Fast Cook-Off/External Fire Stack Test Schematic.

Table 3. Fast Cook-Off/External Fire Stack Test Instrumentation/Equipment.

Item(s)	Qty	Description	Location(s)
blast gage	as req'd	PCB Piezo Electric blast gage (psi range dependent on test article)	Four sets of six gages placed all sides of test article in a single line. Gages are placed 15 ft from test article and extend at increments of 15 ft to 100 ft from test article
heat flux gages/ radiometers	as req'd	User defined	Placed at positions around test article at a distance of 50 ft
thermocouple	4	OMEGA type K	Located ~8 in from test article skin (sampled at 1 Hz intervals)
cameras	2	Panasonic video camera with elapsed time recording capability	Location dependent on expected results. Normally placed at ~45° off test article center
fuel basin	1	contains Jet A-1 fuel or approved substitute with 10 ft of fuel surface on all sides of the test article	Located 1.5 ft below the test article
witness plates	as req'd	80 in x 80 in x 1/16 in aluminum	Placed 13 ft from test article
data recording/reduction equipment	as req'd	must be capable of recording at a minimum rate of 20KHz	Located in protected blast house/test center
signal amplifier	as req'd	PCB signal amplifier	Located in protected blast house/test center
oscilloscope(s)	as req'd	User defined	Located in protected blast house/test center
signal converter box	as req'd	User defined	Located in protected blast house/test center

Table 3. Fast Cook-Off/External Fire Stack Test Instrumentation/Equipment.

Test Procedure

Overview

See Test Description.

Detailed Test Procedures

A flowchart graphically depicting the FCO/EFS test procedure is presented in Figure 2. Test procedures detailing each step of FCO/EFS test process are shown in the following paragraphs.

Step 1. Configure the test area as indicated in the FCO/EFS Test Schematic Figure 2 (actual test configuration is based on the mA and may differ from suggested schematic). If the CS test, the SD test, or the SCJ test indicates a propensity to detonate, as a precaution for adequate data collection, add fragment collection packs similar to those in TB 700-2 for method l.

Step 2. Perform checkout of test stand data recording equipment.

Step 3. Calibrate thermocouples with a heating unit.

Step 4. Prepare and mount two test articles in stack configuration..

Step 5. Prepare a basin of sufficient hydrocarbon fuel (such as Jet A-I) or wood to generate an average flame temperature of 870^0C (1600^0F).

Figure 3. Fast Cook-Off/External Fire Stack Test Flowchart

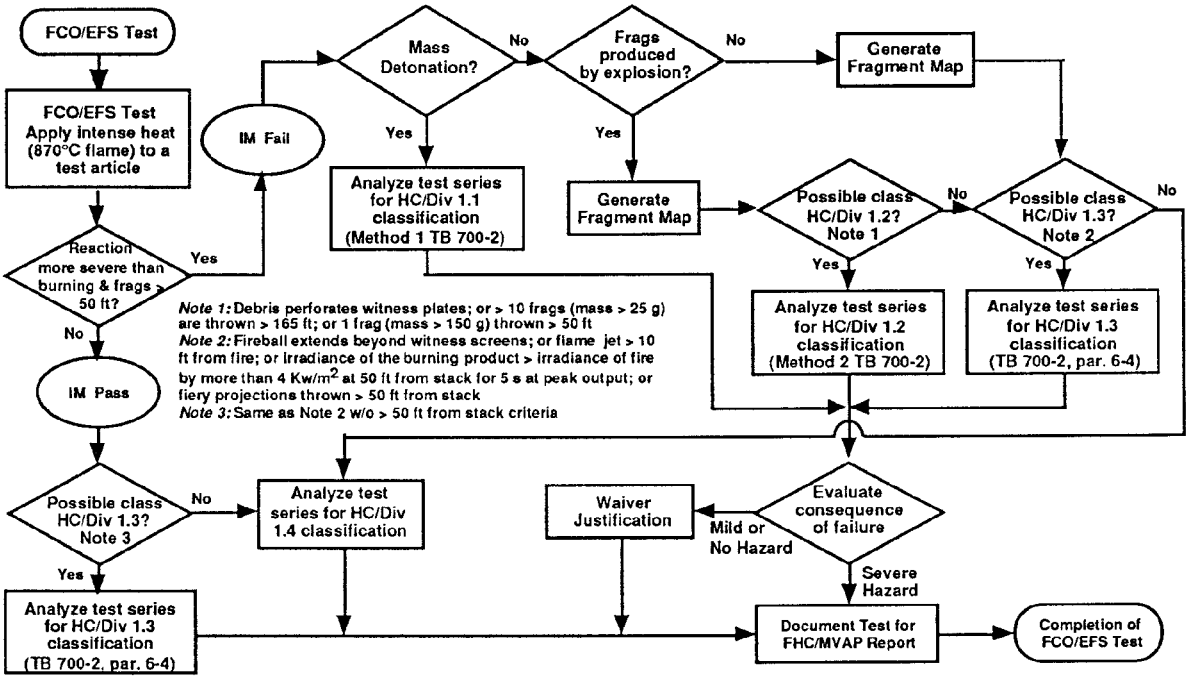


Figure 3. Fast Cook-Off/External Fire Stack Test Flowchart

Step 6. Prepare to execute test - Clear test area of all personnel.

Step 7. Activate data recording/reduction equipment.

Step 8. Ignite basin of flammable material.

Step 9. Collect data, evaluate/assess article reaction.

IM Passing Criteria

No reaction more severe than burning (Type V).

Documentation

Data sheets (Figures 3.6-3, 3.6-4, and 3.6-5) shall be developed documenting the test results and shall comply with DID DI-SAFT-81130 format.

Test Ordnance Disposal

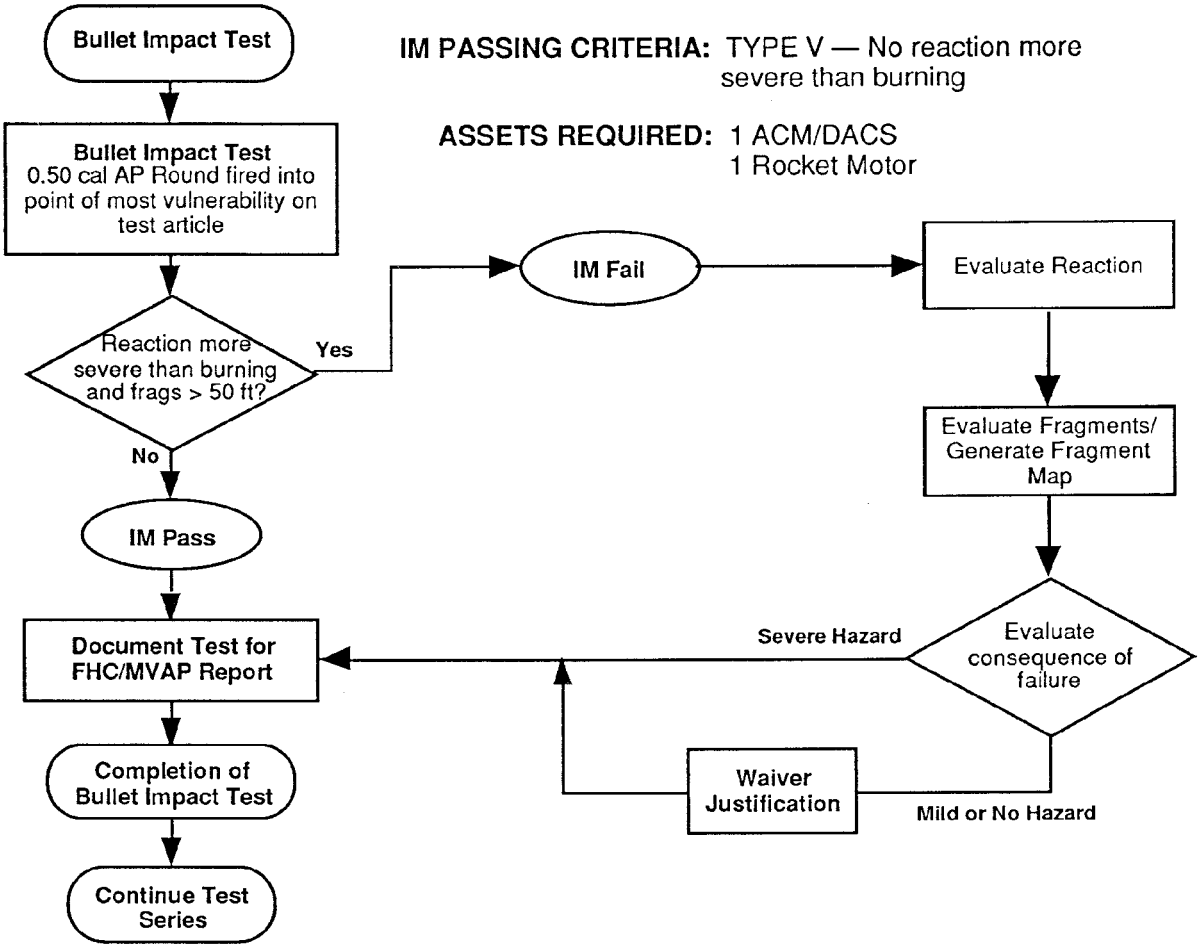
All tested ordnance shall be disposed of as follows:

a) Material which has ignited shall be permitted to burn out.
b) Ordnance which has provided no reaction shall be disposed of preferably by using EOD procedures and EOD certified personnel.

Flowcharts for the Remaining IM/FHC Tests

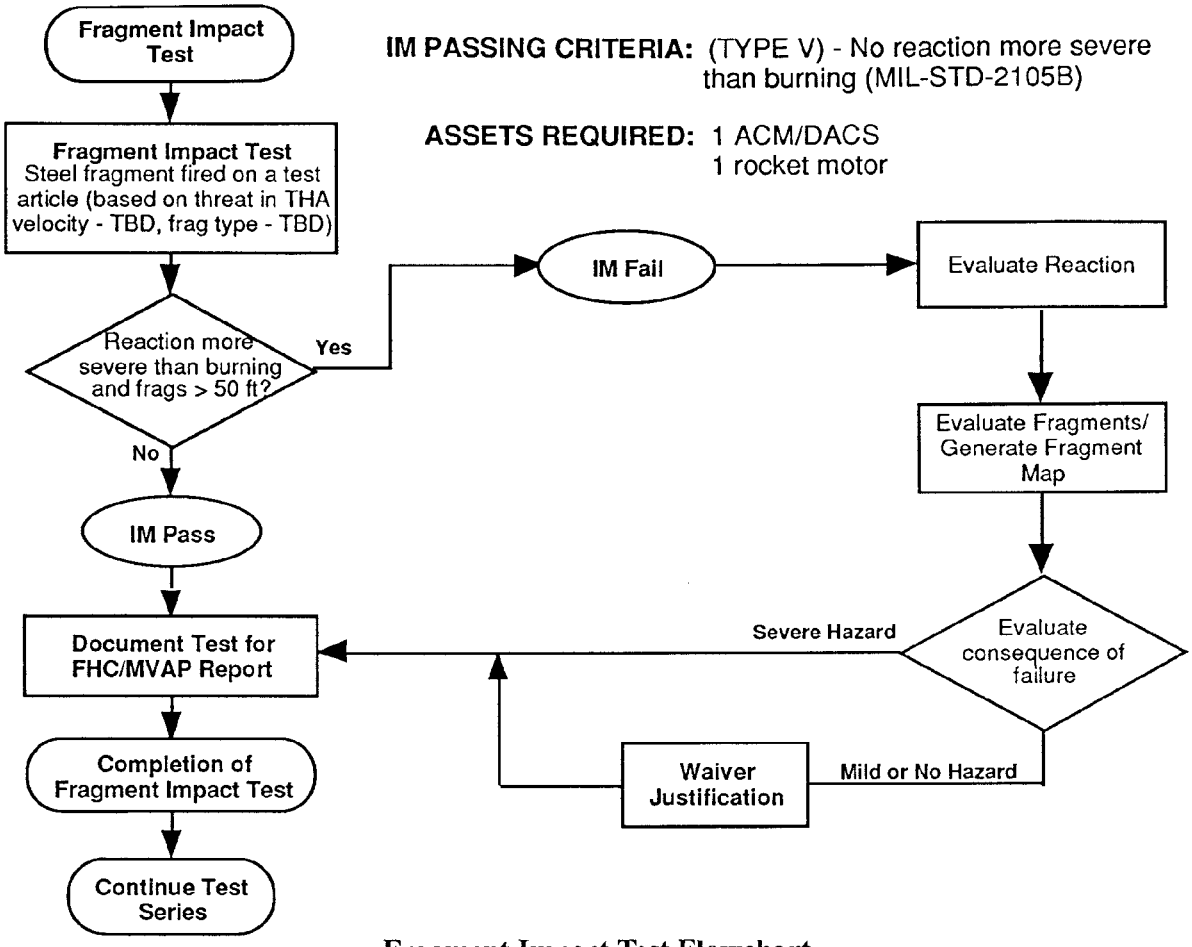
The flowcharts that have been developed for the Bullet Impact, Fragment Impact, Confined Stack, Shaped Charge Jet Impact, and Sympathetic Detonation tests are provided on the following pages.

Bullet Impact Test Flowchart



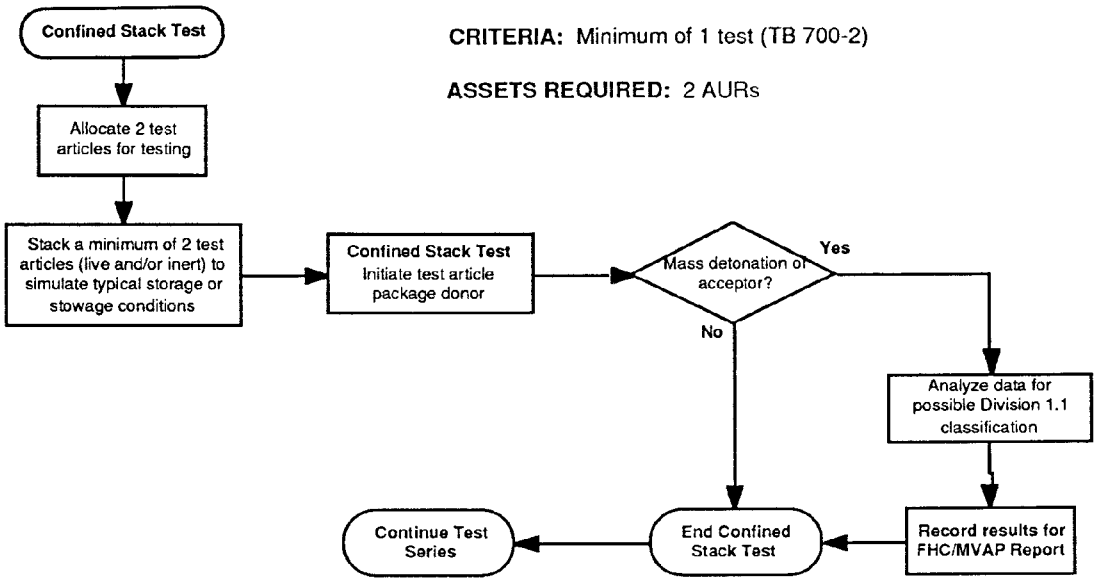
Bullet Impact Test Flowchart

Fragment Impact Test Flowchart

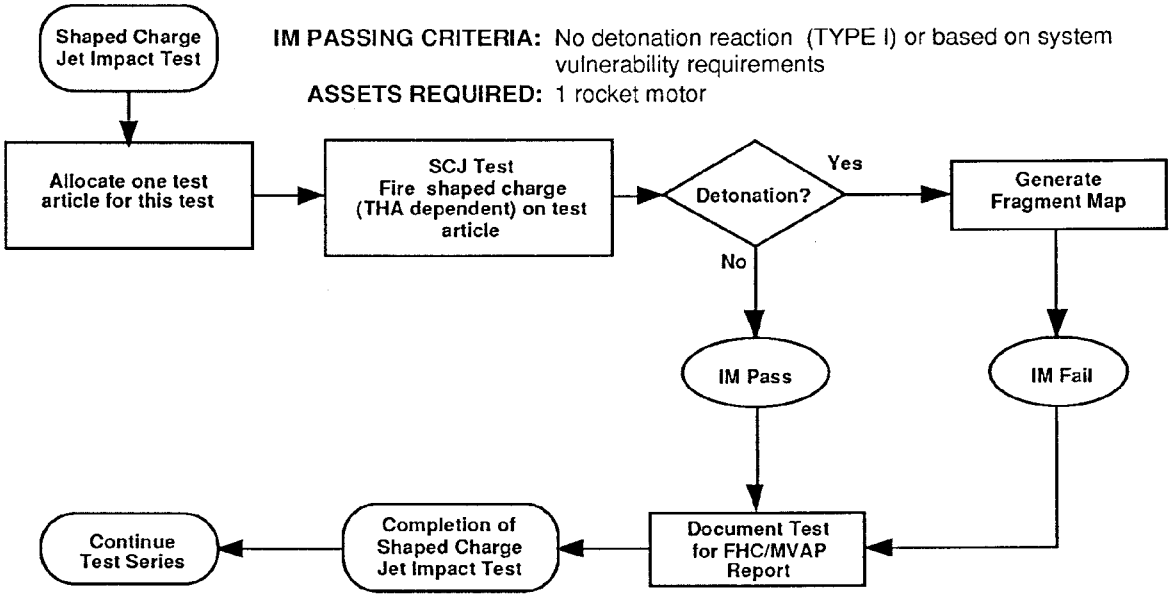


Fragment Impact Test Flowchart

Confined Stack Test Flowchart
and
Shaped Charge Jet Impact Test Flowchart

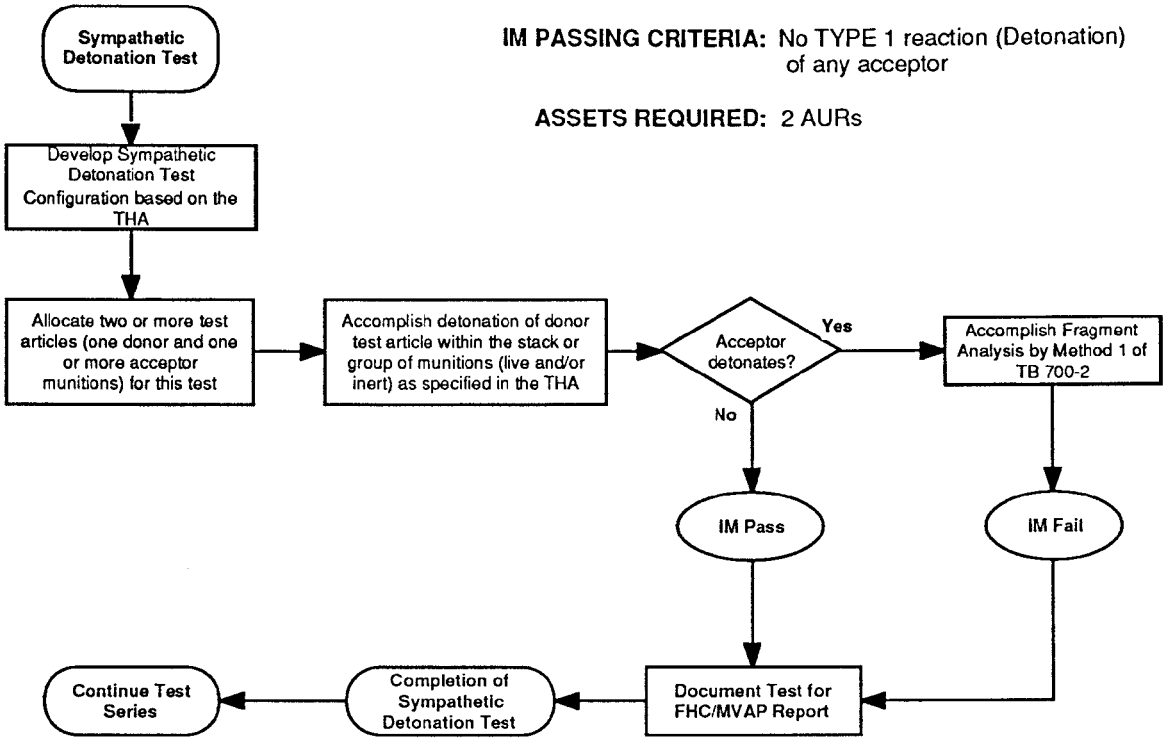


Confined Stack Test Flowchart



Shaped Charge Jet Impact Test Flowchart

Sympathetic Detonation Test Flowchart



Sympathetic Detonation Test Flowchart

Sample Combined IM/FHC Test Schedule

A sample test schedule is provided in Figure 4 which indicates lead times of a typical IM test program. All durations are tentative approximations and are to be used as suggestions only. This assumes a test plan for the specific munition has already been approved through government channels and coordinated with the test agency.

Figure 4. Sample Combined IM/FHC Test Schedule

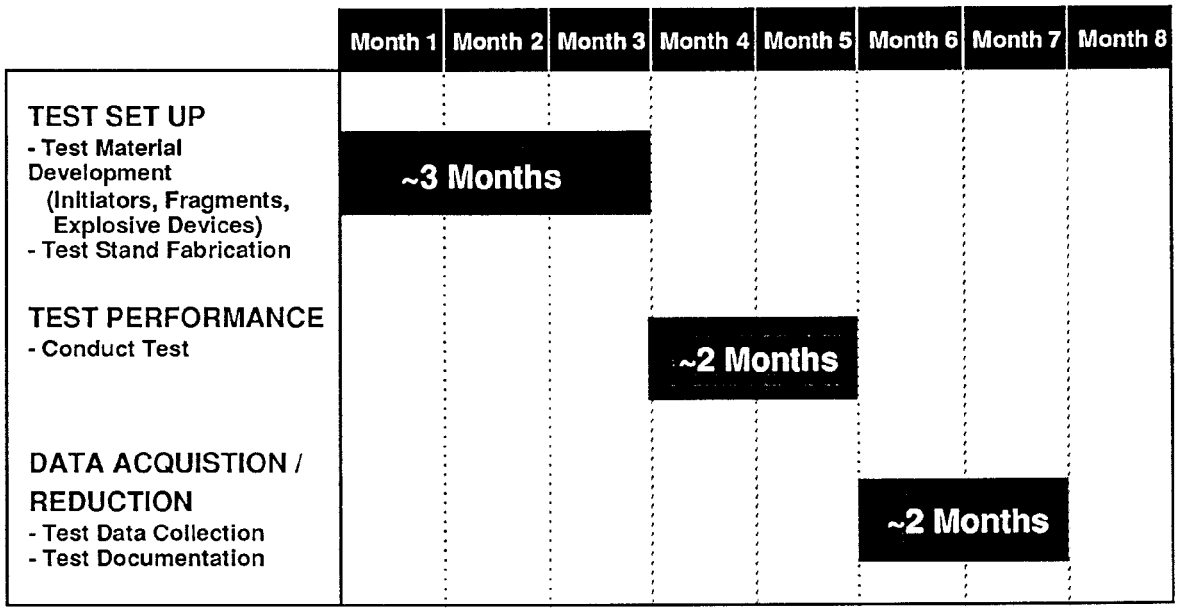


Figure 4. Sample Combined IM/FHC Test Schedule

Summary/Recommendations

To use this generic test plan to it's full advantage, it is recommended that the Threat Hazard Assessment (THA) and the recommended subscale tests discussed in this test plan be completed first.

Using these two pieces of information, a tailored IM/FHC test plan can be developed. Depending on the subscale test results, some of the tests in the generic test plan can be further eliminated. The tailored test plan would be approved by the MVAP (for IM purposes) and the DDESB (for hazard classification purposes) as a revision to the generic combined IM/FHC tests offered in this document. The approval cycle for tailored test plans that have been developed within the frame

work of this approved generic test plan will be accomplished in much less time than similar test plans require. This is due the fact that the detailed test plans will be viewed as revisions to an already approved document by the reviewing boards. The test plan will reduce the required test assets for a successful IM and FHC test program by as much as 75% with no degradation of test data. The implementation of this test plan within the military services will result in considerable cost reductions while thorough and complete IM and FHC test data for the munition in question.

For more detailed information and descriptions consult the approved plan (titled: Combined Insensitive Munitions/Final Hazard Classification Test Plan, dated 7 June 1994). A copy of the plan can be obtained by written request to Deputy Commander, ATTN: CSSD-ES, P.O. Box 1500, Huntsville, Alabama 35807-3801. Technical point of contact is Ms. Patricia Vittitow.

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Reference Documents

1. MIL-STD-2105B: Hazard Assessment Tests for Non-Nuclear Munitions (Jan '94)
2. USA Supplement to MIL-STD-2105A (Jan '92)
3. U.S. Army Insensitive Munitions Master Plan: (Oct '89)
4. U.S. Army Handbook: (Jan '92)
5. DoD TB-700-2: Explosives Hazard Classification Procedures (Draft) (Mar '94)
6. BOE-6000-K: Hazardous Materials Regulations for D.O.T (Oct. '92) (B.U. of Explosives)
7. DoD-6055-9: Ammunition and Explosives Safety Standards (Aug '86)
8. TM 9-1300-214: Military Explosives (Jan '87)
9. MIL-STD-1648A(AS): Criteria and Test Procedures for Ordnance Exposed to an Aircraft Fuel Fire (Sep '82)
10. MIL-STD-1670: Environmental Criteria and Guidelines for Air-Launched Weapons (Jul '76)
11. AR 55-355F: Defense Traffic Management Regulation ('86)
12. TM 9-1300-206: Ammunition and Explosive Standards ('89)
13. DI-SAFT-81126: Photographic Requirements (Mar '91)
14. DI-SAFT-81130: Fast Cook-Off Test Data (Mar '91)
15. DI-SAFT-81132: Bullet Impact Test Data (Mar '91)
16. DI-SAFT-81133: Fragment Impact Test Data (Mar '91)
17. DI-SAFT-81134: Sympathetic Detonation Test Data (Mar '91)
18. DI-SAFT-81135: Shaped Charge Jet Impact Test Data (Mar '91)
19. DI-NDTI-80603: Test Procedure (Jun '88)